FIG. 1

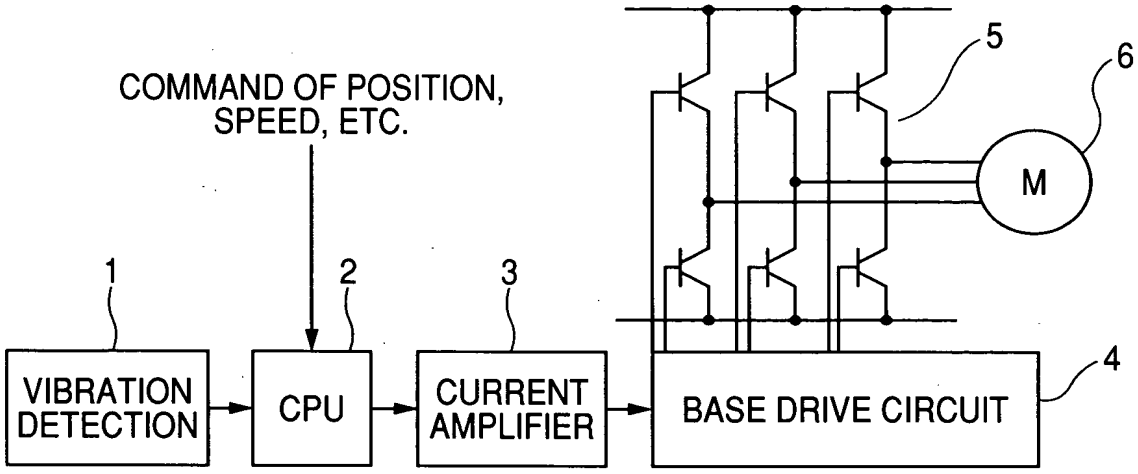

COMMAND OF POSITION,
SPEED, ETC.
1
2
3
5
6
M
4
VIBRATION DETECTION
CPU
CURRENT AMPLIFIER
BASE DRIVE CIRCUIT

FIG. 2

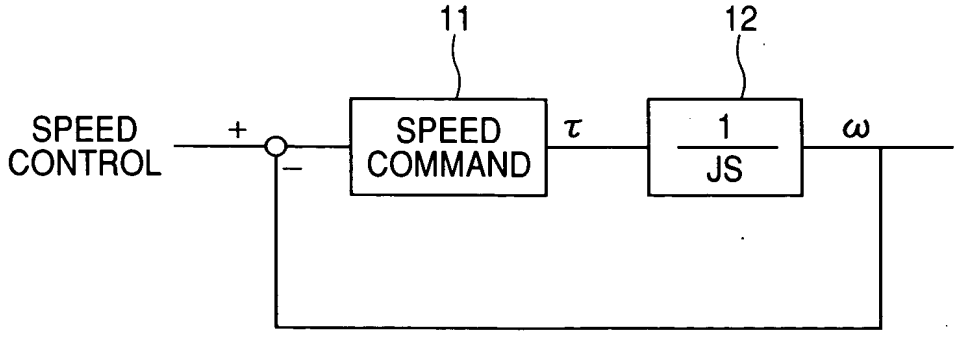

11
12
SPEED CONTROL
+
−
SPEED COMMAND
τ
1
JS
ω

FIG. 3

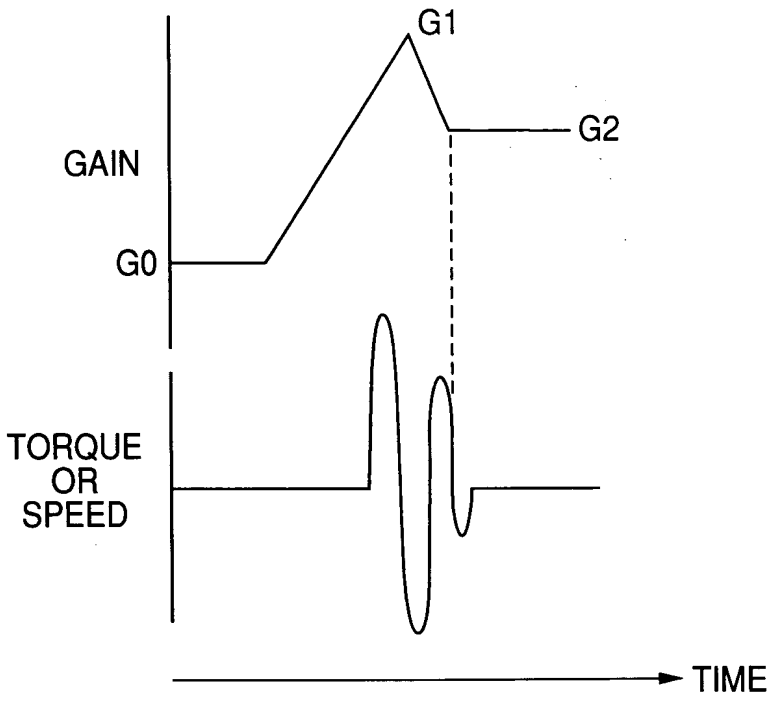


FIG. 4

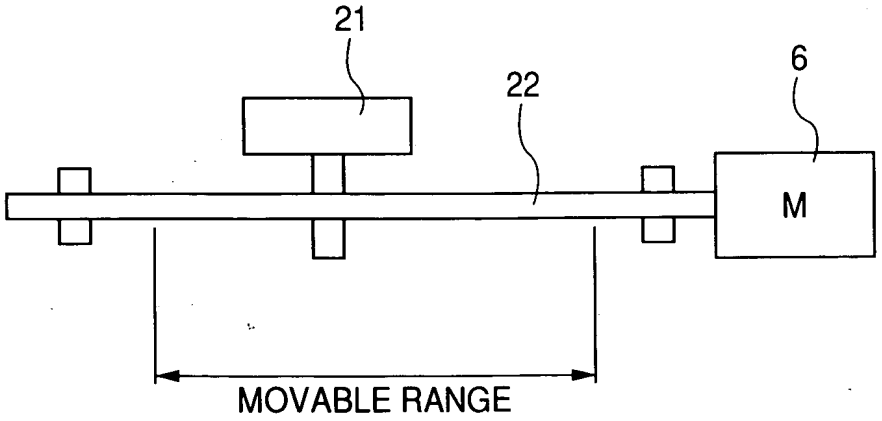


FIG. 5

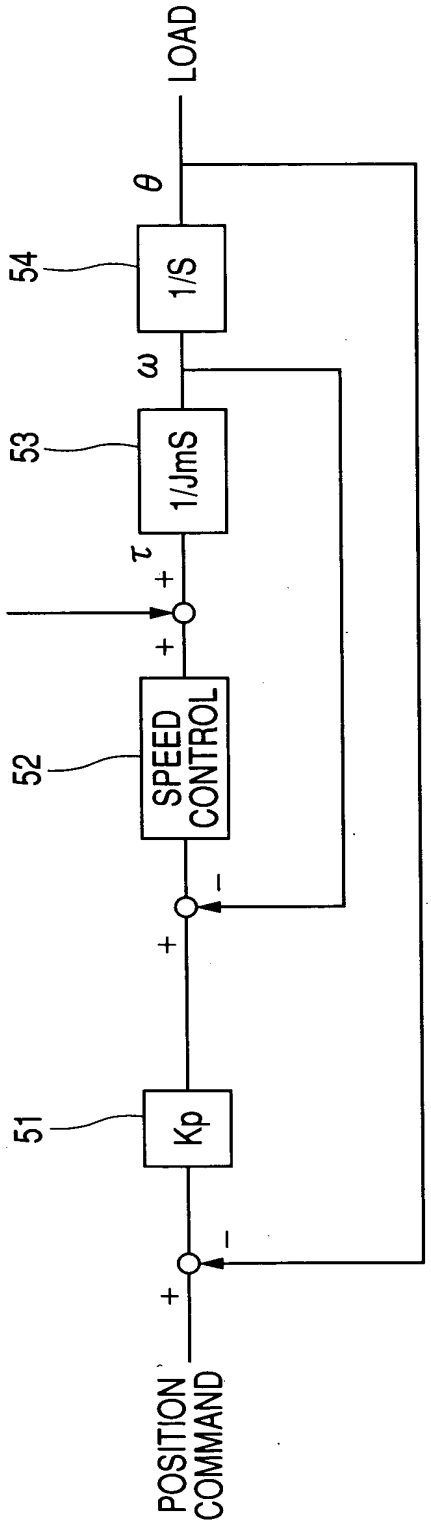

LOAD
θ
54
1/S
ω
53
1/JmS
τ
+
+
52
SPEED CONTROL
−
+
51
Kp
−
+
POSITION COMMAND

FIG. 6

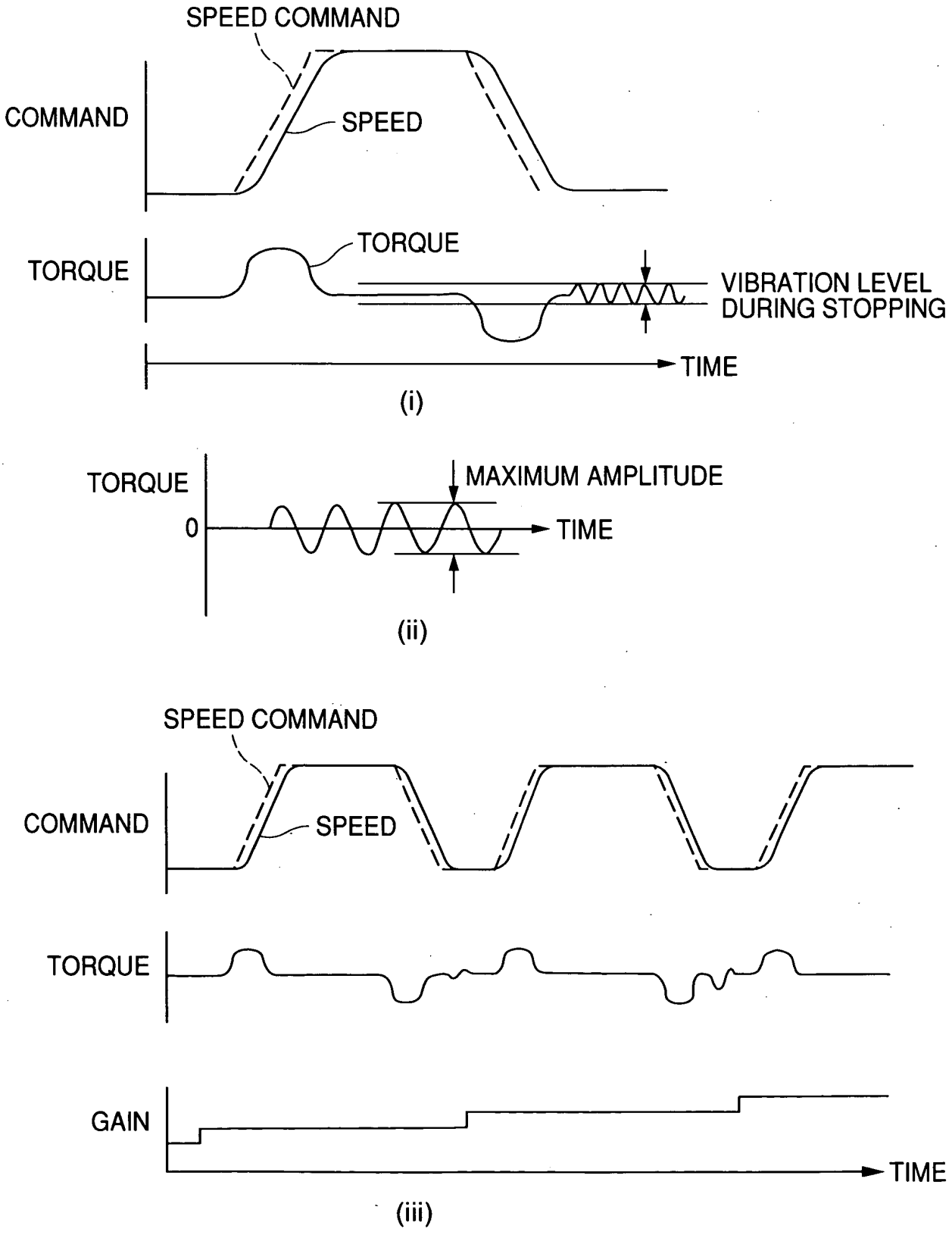

SPEED COMMAND
COMMAND
SPEED
TORQUE
TORQUE
VIBRATION LEVEL
DURING STOPPING
TIME
(i)
TORQUE
MAXIMUM AMPLITUDE
0
TIME
(ii)
SPEED COMMAND
COMMAND
SPEED
TORQUE
GAIN
TIME
(iii)

FIG. 7

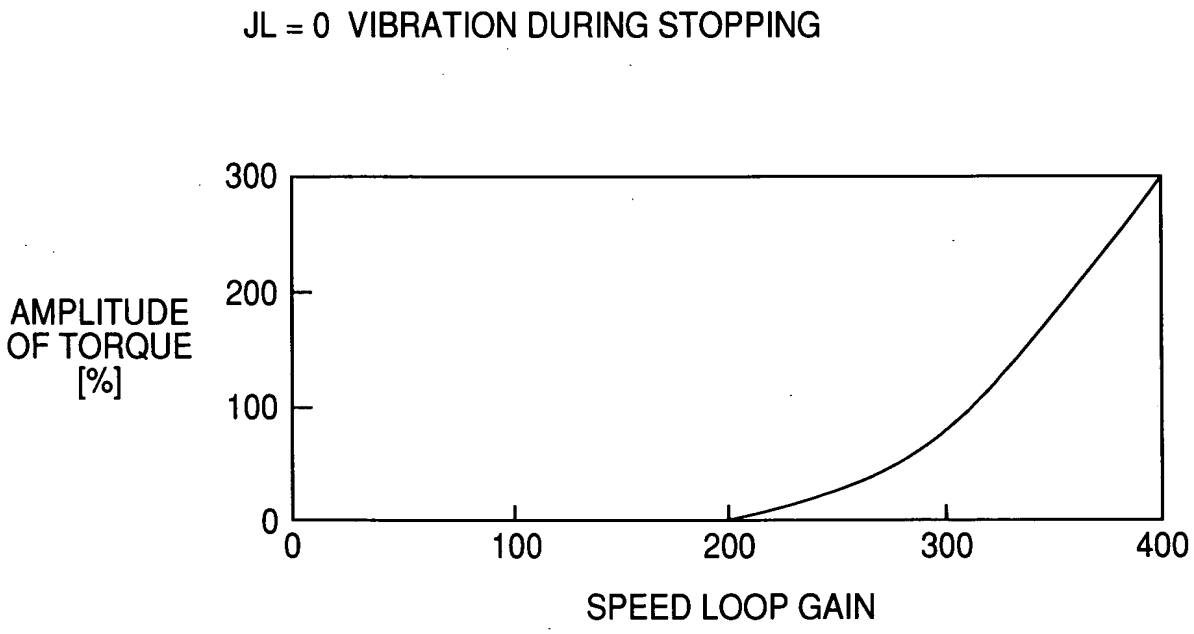

JL = 0 VIBRATION DURING STOPPING
AMPLITUDE OF TORQUE [%]
300
200
100
0
0
100
200
300
400
SPEED LOOP GAIN

FIG. 8

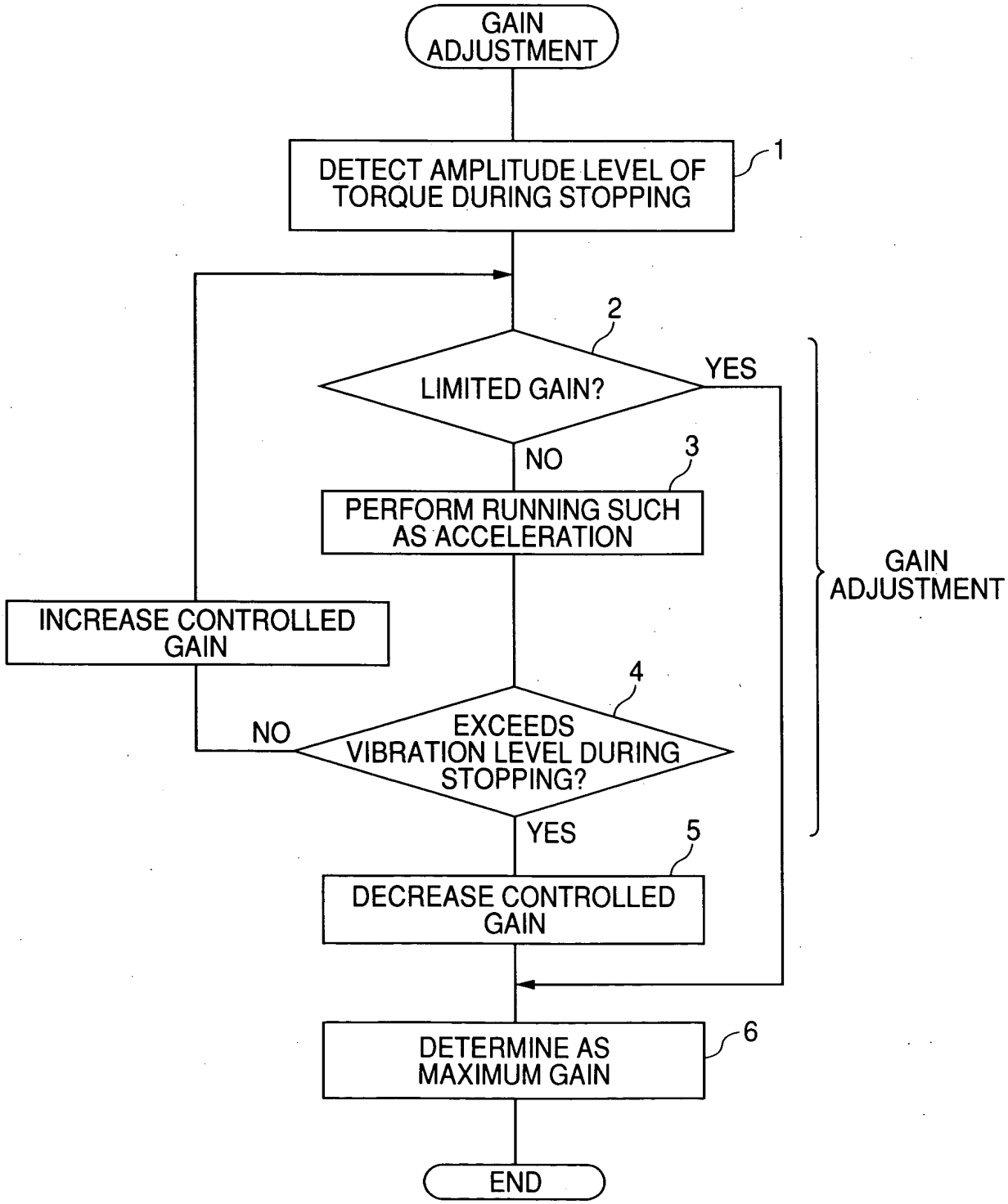

GAIN ADJUSTMENT
DETECT AMPLITUDE LEVEL OF TORQUE DURING STOPPING
1
2
LIMITED GAIN?
YES
NO
3
PERFORM RUNNING SUCH AS ACCELERATION
INCREASE CONTROLLED GAIN
4
NO
EXCEEDS VIBRATION LEVEL DURING STOPPING?
YES
5
DECREASE CONTROLLED GAIN
GAIN ADJUSTMENT
DETERMINE AS MAXIMUM GAIN
6
END

FIG. 9

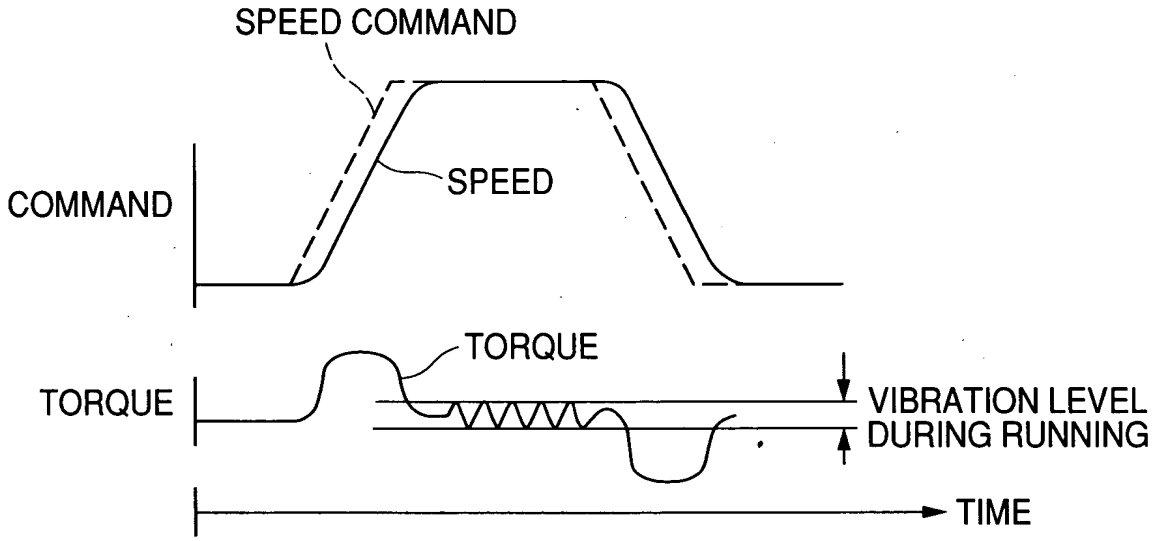

SPEED COMMAND
SPEED
COMMAND
TORQUE
TORQUE
VIBRATION LEVEL
DURING RUNNING
TIME

FIG. 10

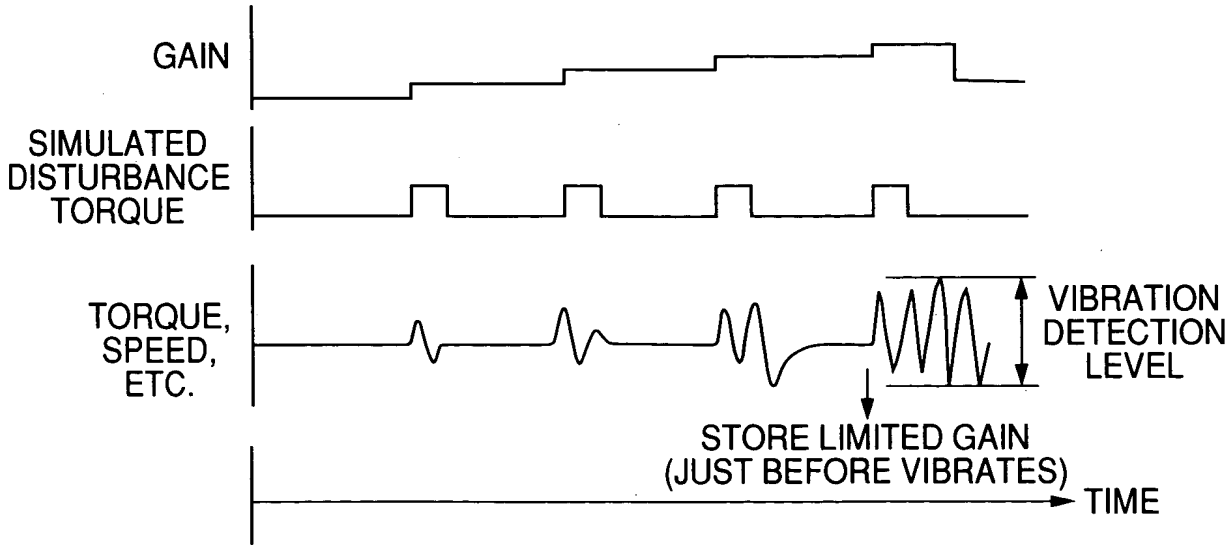

GAIN
SIMULATED
DISTURBANCE
TORQUE
TORQUE,
SPEED,
ETC.
VIBRATION
DETECTION
LEVEL
STORE LIMITED GAIN
(JUST BEFORE VIBRATES)
TIME

FIG. 11

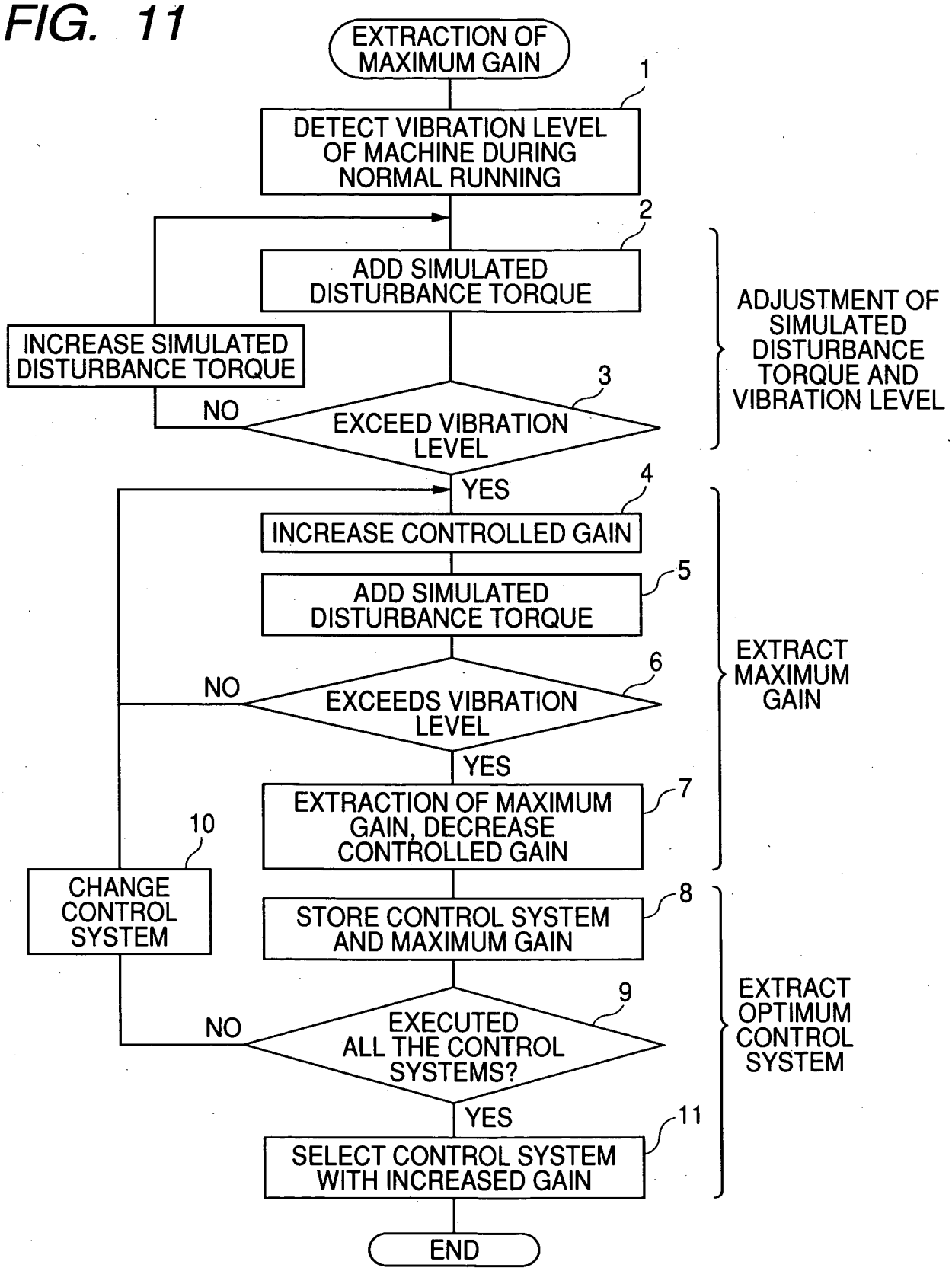
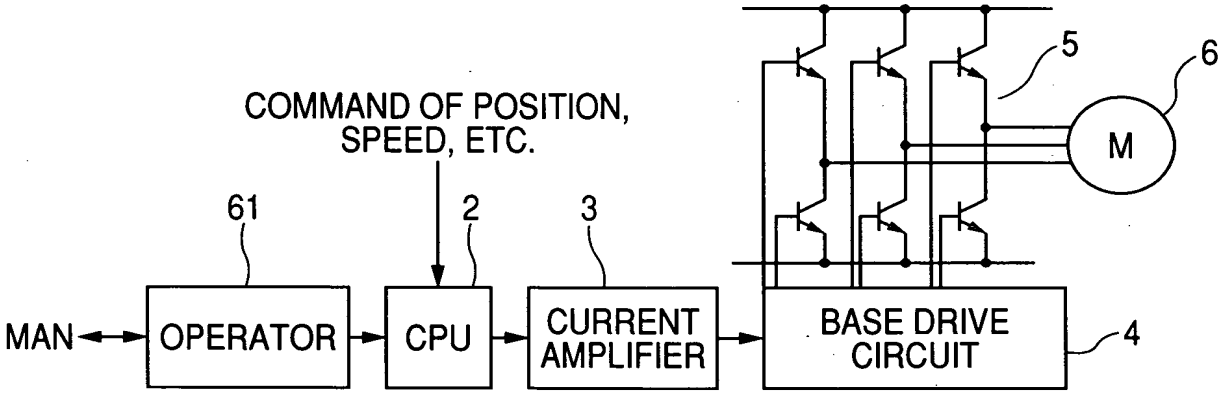

EXTRACTION OF MAXIMUM GAIN
1
DETECT VIBRATION LEVEL OF MACHINE DURING NORMAL RUNNING
2
ADD SIMULATED DISTURBANCE TORQUE
INCREASE SIMULATED DISTURBANCE TORQUE
NO
3
EXCEED VIBRATION LEVEL
YES
ADJUSTMENT OF SIMULATED DISTURBANCE TORQUE AND VIBRATION LEVEL
4
INCREASE CONTROLLED GAIN
5
ADD SIMULATED DISTURBANCE TORQUE
NO
6
EXCEEDS VIBRATION LEVEL
YES
7
EXTRACTION OF MAXIMUM GAIN, DECREASE CONTROLLED GAIN
EXTRACT MAXIMUM GAIN
10
CHANGE CONTROL SYSTEM
8
STORE CONTROL SYSTEM AND MAXIMUM GAIN
NO
9
EXECUTED ALL THE CONTROL SYSTEMS?
YES
11
SELECT CONTROL SYSTEM WITH INCREASED GAIN
EXTRACT OPTIMUM CONTROL SYSTEM
END

FIG. 12



(SEQUENCE PROCESSING)

FIG. 13

EXEMPLARY SEQUENCE

1 . MOVE IN MOVABLE RANGE
2 . INCREASE
3 . OBSERVE VIBRATION → INCREASE GAIN SLIGHTLY IF VIBRATION OCCURS
4 . FAST MOVE IN MOVABLE RANGE
5 . CONFIRM POSITIONING IN AT NORMAL SPEED
6 .

FIG. 14

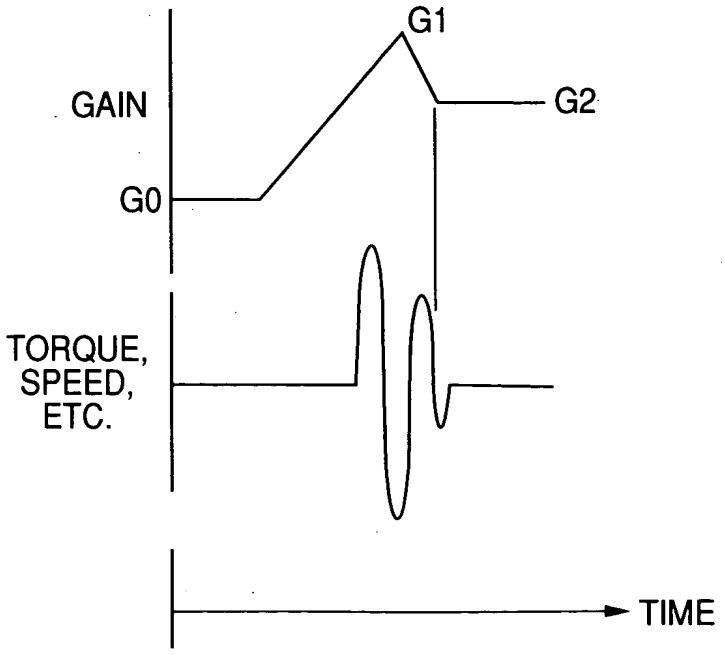


FIG. 15

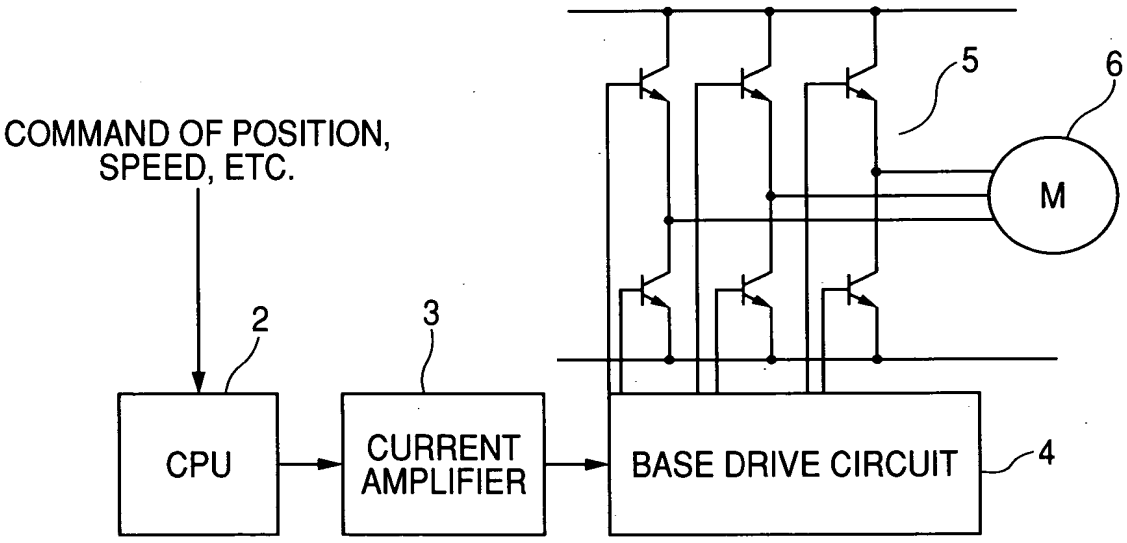

COMMAND OF POSITION,
SPEED, ETC.
2
3
5
6
M
CPU
CURRENT
AMPLIFIER
BASE DRIVE CIRCUIT
4

FIG. 16

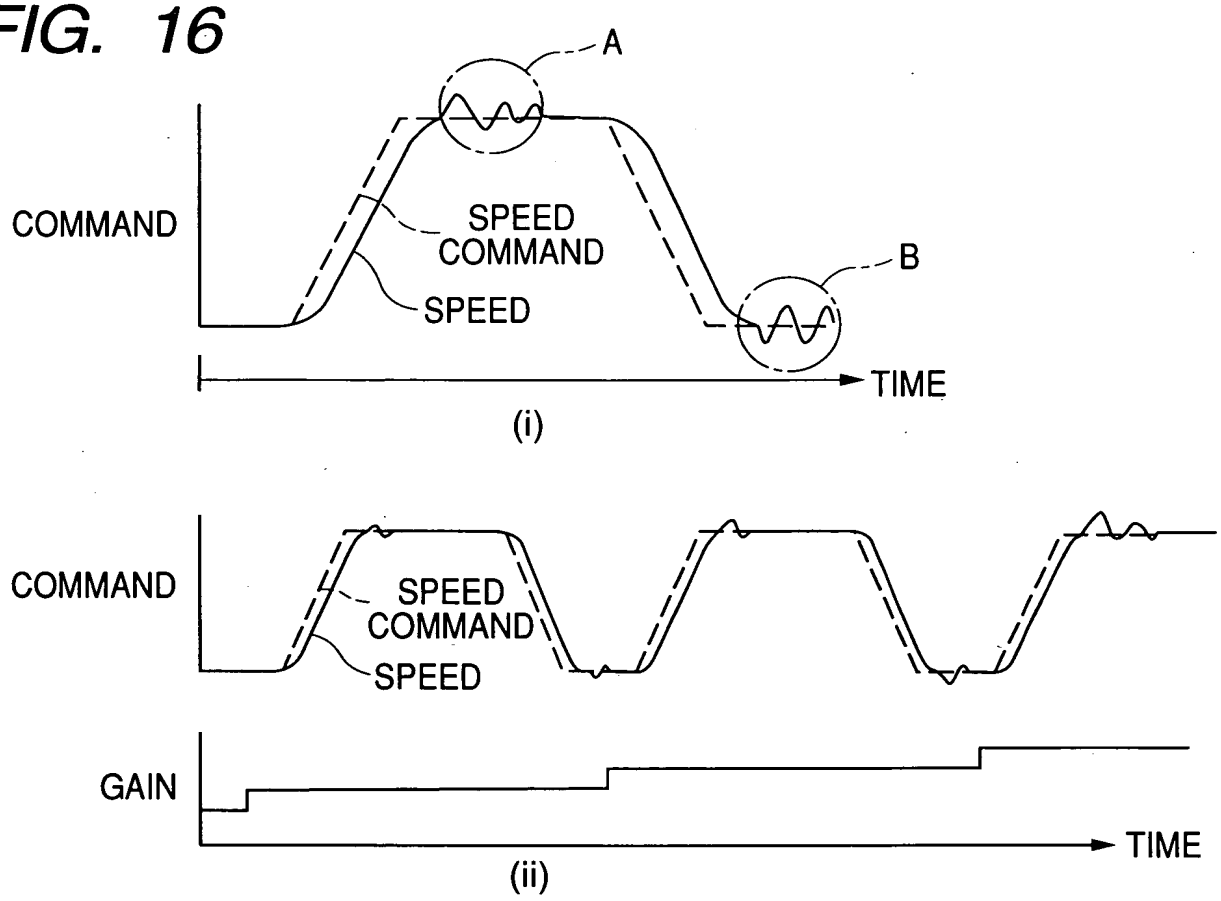
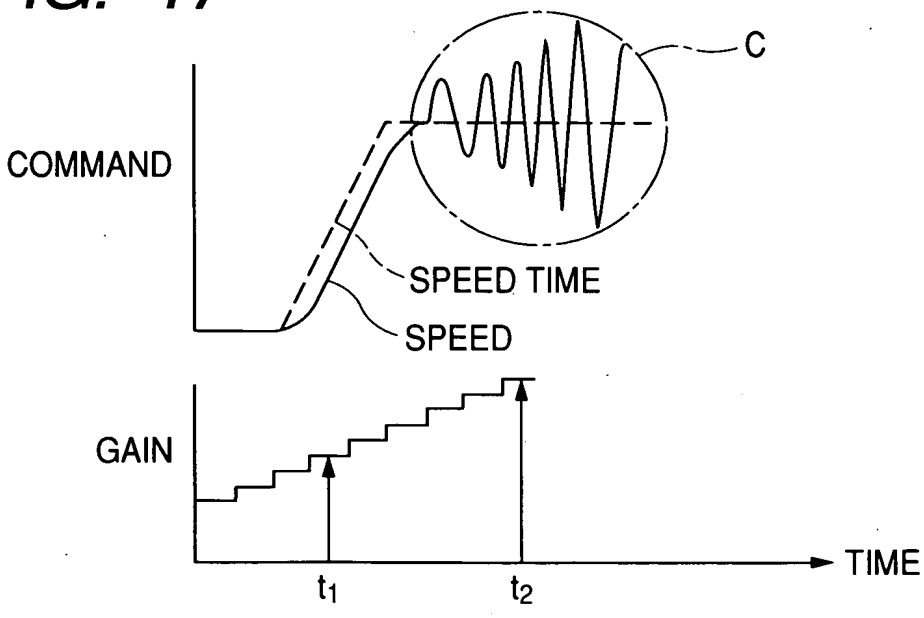

A
COMMAND
SPEED COMMAND
SPEED
B
TIME
(i)
COMMAND
SPEED COMMAND
SPEED
GAIN
TIME
(ii)

FIG. 17


C
COMMAND
SPEED TIME
SPEED
GAIN
TIME
t1
t2